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ELECTRONIC DEVICES in Telephony

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***THIRD OF A SERIES** of articles on electronics and electronic devices used in telephone work. The first one, published February 11, presents basic vacuum tube principles; the second, published March 4, discusses the application of these principles to thermionic diodes and triodes. This article takes up multi-electrode tubes, known as tetrodes and pentodes.*

IN THIS series thus far, the basic principles of electronics have been discussed, and the application of these principles to diodes and triodes treated Had this series been written only a few years ago, a treatment of the so-called multi-electrode tubes—that is, the tetrodes and pentodes—would have been unnecessary. Only very recently have these become of importance in telephony.

The special construction of the screen-grid tetrode (or just screen-grid tube) and the suppressor-grid pentode gives these tubes very high amplification compared with the triode considered in the previous article. In the conventional telephone circuits, only a small amount of amplification could be used at any one point because of the danger of excessive crosstalk. The triode was, therefore, entirely satisfactory for the repeaters used in these circuits.

In the newer types of circuits (Bell System Technical Journal, January 1938), however, the individual repeaters are operated at high gains, and thus high-amplification tubes, such as the tetrodes and pentodes, may be used. At least two factors have made this possible; first, special circuit arrangements such as the use of isolated four-wire talking circuits (one pair for each direction), and second, the development by Black and his associates of the feed-back amplifier in which high gain does not result in instability.

The Screen-Grid Tetrode

In the screen-grid tetrode, a second screening or shielding grid is placed between the control grid and the plate. Furthermore, this screen grid usually covers the outside of the plate, so that the plate is in reality entirely enclosed in a screen.

The presence of this screen has a very pronounced effect on the characteristics of the tube under operating conditions. From the preceding article of this series (TELEPHONY of March 4) it is seen that the amplification factor of the tube is a measure of the effectiveness of the plate, as compared to the grid, in controlling the plate current. Now, if the plate is well shielded by the screen grid, it is obvious that the positive plate potential will not greatly affect the current to the plate, thus giving the control grid a large measure of control, and giving the tube a high amplification factor.

This resulting high amplification is not the only advantage of the screen-grid tube. When a triode is used to amplify radio frequencies, a voltage is fed back through the grid-plate capacitance; and this voltage may cause the tube to oscillate. In the screen-grid tube, this feedback is largely prevented except at very high radio frequencies. As the frequencies used in carrier telephony become higher, this advantage of the screen-grid tube grows in importance.

The circuit of Fig. 1 is convenient for studying the screen-grid tetrode over the usual range of operation. For obtaining the set of curves given in Fig. 2, all other electrode potentials are held constant, and the plate voltage E_p is varied.

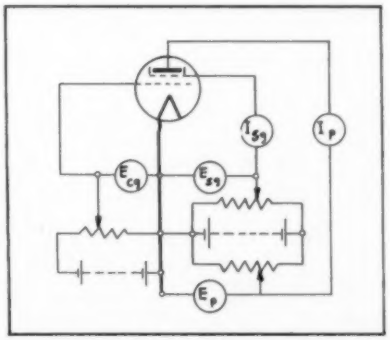

Fig. 1. Circuit for studying a screen-grid tetrode. The variable voltage dividers connected across the batteries make possible wide variations in electrode voltages.

At each value, the plate current I_p and the screen-grid current I_{s_2} are noted and plotted as indicated.

For convenience, the curves of Fig. 2 have been broken into several parts, and they will be explained with reference to these parts. As stated in the preceding paragraph, all electrodes are at normal operating values, and the plate voltage is being varied; that is, the filament is at operating temperatures, the control grid is at the correct negative value, and the screen grid is at the correct positive value.

Thus, at point 1, since the screen grid is positive and the plate is at zero volts, the screen grid takes all the current available from the space-charge region near the filament. As the plate becomes more positive, it takes a certain amount of this current, because some electrons, due to their inertia, will pass through the spaces of the screen grid, and the plate will capture them. After point 2 is passed, the plate current starts to decrease, and the screen-grid current to increase because of secondary emission from the plate.

This phenomenon of secondary emission is very interesting, and occurs in the following manner: At point 2, the screen grid is at its high fixed potential of about + 90 volts. It, accordingly, attracts a large stream of electrons, and the inertia of some of these carry them through the meshes of the screen grid and into the vicinity of the plate. The plate, although it is only at a relatively low positive potential, further accelerates these electrons and draws them to it.

Now, when these electrons strike the plate, some of them may have enough energy to knock one or more electrons out of the plate. These liberated electrons are called *secondary electrons*, and the phenomenon is *secondary emission*. If the plate were at a high positive potential compared to the screen grid, it would pull them back and capture these electrons, but since it is not, these secondary electrons flow (back) to the positive screen grid. This causes the net current to the plate to decrease, and the screen-grid current to increase as indicated at point 3. It is suggested that the reader verify this theory by carefully studying Fig. 1.

As the plate potential is made more and more positive, the plate captures an increasingly large percentage of the secondary electrons, until at last they are all drawn back to it. In addition, as the plate potential reaches and exceeds that of the screen grid, the plate takes a larger current from the space-charge region. Thus, the plate current increases and the screen-grid current decreases as indicated by point 4.

Between this point and point 5, only a slight increase in plate current and a corresponding decrease in the screen-grid current are noted. Attention is called to the fact that over this region large increases in plate voltage *do not* produce correspondingly large increases in plate current.

The next factor to be investigated will be the influence of the grid voltage on the plate current, with all other potentials at normal values as indicated on Fig. 3. This curve is seen to be quite similar to the corresponding curve for a triode.

Since the electrons constituting the current to the plate must pass through the control grid, and since this control grid is close to the filament and the dense negative space-charge region, the control grid exerts a pronounced effect on the current to the plate. As Fig. 3 shows, if the control grid is only a few volts negative, the current to the plate is reduced to zero.

As the preceding paragraphs have stressed, the screen-grid tetrode has two important characteristics: *First*, over the range of normal operation —that is, between about 60 and 200 volts for Fig. 2—wide variations in plate voltage cause but small changes in the plate current. *Second*, at these same operating values, the control grid is able to exert a pronounced influence on the plate current.

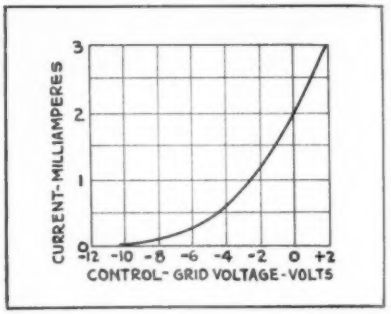

Fig. 3. Control grid voltage-plate current curves for a screen-grid tube or tetrode.

Screen-Grid Tetrode Coefficients

Thus, as was previously brought out, the screen-grid tetrode will have a high amplification factor. This factor is in reality a measure of the effectiveness of the control grid with respect to the plate in controlling the plate-current flow. For the tube illustrated in Figs. 2 and 3, this factor exceeds 600, as compared with a value of about 10 for a typical triode.

This high amplification factor is one of the distinguishing features of the screen-grid tetrode. It should be mentioned at this time, however, that this high amplification factor cannot be fully utilized either in the tetrode or in the pentode to be considered later.

Another important characteristic of this tube is a very high plate resistance. This value can be approximately determined from Fig. 2. The tube is operated between about 60 and 200 volts, and over this region the curve is substantially flat. Since the plate resistance is the reciprocal of the slope of this curve(just as explained for the triode), the plate resistance is very high, usually being several hundred thousand ohms.

The Suppressor-Grid Pentode

The screen-grid tetrode just considered was a marked improvement over the older triode in many ways. Its advantages were especially important in radio-frequency voltage amplifiers. Nevertheless, this tetrode also has some disadvantages as

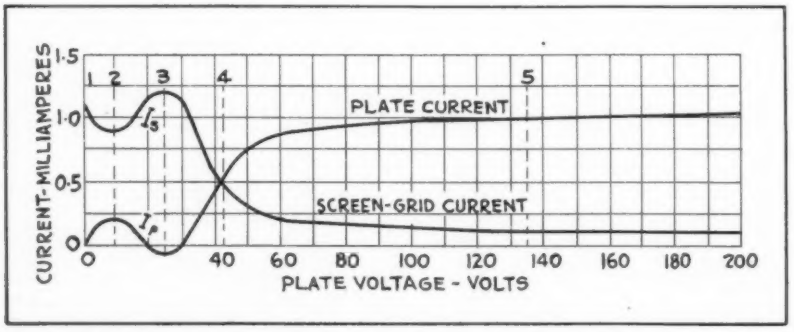

Fig. 2. Plate voltage-plate current and plate voltage-screen grid current characteristics of the screen-grid tube or tetrode.

will now be pointed out. As was mentioned, the tube was operated between about 60 and 200 volts for Fig. 2; that is, the plate voltage must not be allowed to fall to a value comparable to that of the screen grid. This limits the operation of the tube.

To reduce the effects of secondary

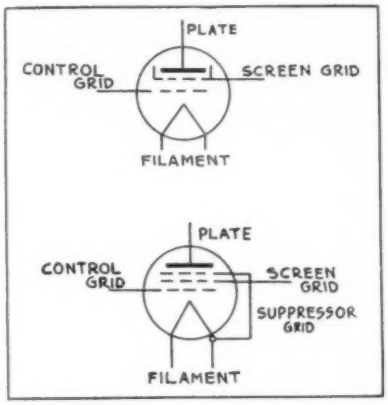

Fig. 4. Electrode arrangements in tetrode and pentodes. In some pentodes, internal connections from suppressor grid to filament or cathode are made. In others, the connection is external. The screen-grid tetrode is shown in the upper diagram and the suppressor-grid pentode in the lower.

emission, the suppressor-grid pentode was developed. In this tube, a third grid is inserted between the screen grid and the plate, and this grid is connected directly to the filament, or to the cathode externally in the separate-heater tube.

Now, the suppressor grid does not *prevent* secondary emission, it merely controls it. Since the suppressor grid is at the potential of the filament, and is *between* the plate and the screen grid, it prevents the secondary electrons *emitted* from the plate from flowing back to the screen grid, even if the plate voltage drops to a value *below* that of the screen grid. The electrode arrangement in a suppressor-grid pentode as compared to that in a screen-grid tetrode is shown in Fig. 4.

Suppressor-Grid Pentode Characteristics

The circuit of Fig. 1 may be used to study the suppressor-grid pentode. Assuming that all other electrodes are energized at the proper potentials, and that the plate voltage is varied, plate-current values as in Fig. 5 will be obtained. It is to be noted that, even when the plate is at a potential below that of the screen grid, the effects of secondary emission do not cause the erratic variations as in Fig. 2.

Of course, secondary emission still occurs, but its effects are not apparent because the suppressor grid is at the potential of the cathode and hence prevents the electrons from flowing back to the screen grid. The fact that the suppressor grid further shields the plate gives the plate even less control of the plate current flow from the cathode.

If now, all other electrode potentials are held constant and the control-grid voltage is varied, a curve of the same general slope as Fig. 3 is obtained for the suppressor-grid pentode.

As was mentioned in discussing the screen-grid tube, the shielding effect of the screen grid reduces the capacitance between the plate and control grid and hence makes high-frequency amplification without special neutralizing circuits to prevent feedback. The fact that an additional grounded grid is inserted between the plate and control grid in the suppressor-grid pentode further reduces the capacitance, and makes high-gain, high-frequency amplification even better than with the screen-grid tetrode.

Suppressor-Grid Pentode Coefficients

As was just mentioned, the grid voltage-plate current curve of the suppressor-grid pentode is similar to that of the screen-grid tetrode; in fact, this curve is even steeper for most pentodes. Now, as Fig.5 shows, the plate voltage-plate current curve is very flat.

Thus, if the control grid has a pronounced effect on the plate current, and the plate has but little effect, the result is that the suppressor-grid pentode will have a very high amplification factor. Such is the case, and an amplification factor of over 1,500 is common for the voltage-amplifying type (as distinguished from the power-output pentode).

The plate resistance of this suppressor-grid pentode is also very high. This is indicated by the flatness of the curve of Fig. 5, since the slope approaches zero, and the internal or plate resistance of the tube is the reciprocal of the slope at the point of operation. In fact, values of plate resistance of over 1,500,000 ohms are common with suppressor-grid pentodes.

Super-Control Tubes

As was mentioned in a previous article, the amplification factor and the plate resistance of a tube are not constant, but vary to some extent. In certain circuits, which will be considered in a later article, a variable amplification factor is desired, and the tube is so constructed that the amplification factor varies widely over the range of operation.

There are several ways by which a variable amplification factor can be obtained, the most common being an unsymmetrical arrangement of the grid wires. The desired value of the amplification factor is selected by adjustments of the electrode operating potentials. These tubes, which include both tetrodes and pentodes, are called variable-mu or, more popularly, super-control tubes.

Separate-Heater Cathodes

Filament-type tubes have been considered throughout the previous articles because of their simplicity. Such tubes are, in general, suited only for use in circuits utilizing direct current for heating the filament. In circuits in which alternating current is used, a separate heater arrangement must be employed. One of the important reasons for this is that alternating-current hum can be reduced to a minimum with the separate-heater construction.

Although there are variations of the principle, the general construction of the separate-heater cathode is a cylindrical tube of nickel or other suitable material on the surface of which is placed the conventional electron-emitting oxide coat-

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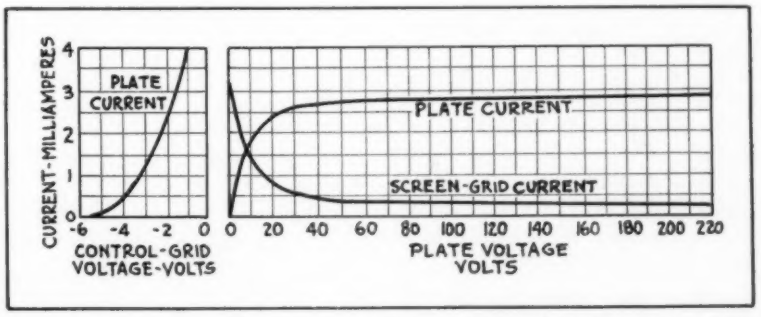

Fig. 5. Characteristic curves for a typical suppressor-grid pentode of the voltage-amplifying type as distinguished from the power output pentode.

Wage-Hour Administrator Andrews—

WHAT WILL YOU DO ABOUT THIS?

EARLY IN February bills were introduced in both branches of Congress to amend the federal Wage-Hour law (the correct name is "Fair Labor Standards Act of 1938") so as to exempt from the wages and hours sections of the law, telephone operators in exchanges of 1,000 subscribers or less.

The Senate bill (the number is S.1234) was introduced by Senator Clyde M. Herring of Iowa. An identical bill was introduced in the House by Representative Vincent F. Harrington, also of Iowa (the number is H. R. 3842). Other identical bills were introduced in the House by several other Representatives familiar with the situation of Independent telephone exchanges under the federal Wage-Hour law as it now stands.

These bills were referred to the committee on education and labor of the Senate, and the committee on labor in the House. These committees then—as is customary—referred the bills to the department of the government interested. In this case it was, of course, the wage and hour division of the Department of Labor. This is the division of which Elmer F. Andrews is administrator.

Administrator Andrews referred the matter to the economics section of his organization, and on February 14 Carroll R. Daugherty, the head of this section, sent a telegram to every state, addressed to the public service commission or the comparable body in such state. This telegram asked the advice and opinion of these state regulatory bodies regarding the size of telephone exchanges that should be exempted from the provisions of the federal Wage-Hour law.

The telegram asked if telephone exchanges should be exempted by number of telephones; if so, by what number? Or if they should be exempted by population of the town in which they operate; if so, by what population? Or if they should be exempted by annual exchange service revenues; if so, by what amount of annual revenue?

MR. DAUGHERTY did, it seems to us, a very sensible and proper thing in asking the advice and opinion of these state regulatory bodies. These commissions have for a number of years passed upon and regulated the charges for services—as well as, in some instances, operating practices and so on—of the telephone exchanges in their respective states. They know, better than other governmental agencies in the country, the situation and status of the telephone industry in their respective states.

They regulated the telephone companies in those feverish days of hectic prosperity before the time of the Great Depression; they went through the depression with the telephone companies. In many instances, by their sound and far-seeing judgment, backed by their historic as well as fundamental knowledge of the telephone industry, they kept telephone companies alive to serve the public when a short-sighted policy on their part would have resulted in the "folding up" of many Independent companies.

To put it another way, the state commissions have generally and in a broad way regulated the Independent telephone industry so as to provide the greatest possible good for the public it serves, including particularly the farmers and the people of small towns who have Independent telephone service.

The telephone companies and the state commissions do not see eye to eye on everything, of course. There have been many clashes between them. The state commissions are not advocates for the telephone companies; they are not dominated by the telephone companies. Their actions and opinions are, on the whole, those designed to serve the users of telephone service. These facts serve to make their advice and opinions on this wage-hour matter all the more important.

WE DO NOT know how much Administrator Andrews and Chief Economist Daugherty know about the telephone business, but we do feel that they do not know any more about it than these state commissions, which have been engaged in regulating it for so many years. Therefore, it is interesting to know what these commissions replied to Mr. Daugherty. It is also going to be interesting to know what consideration Mr. Andrews and Mr. Daugherty give to these replies.

We have not seen the replies made by all state commissions to Mr. Daugherty's questions, but we are familiar with the answers given by 37 of them. (There are some states with no commissions, and some in which the commission does not regulate telephone companies; also, there are some commissions that did not, for various reasons, reply to the inquiry.) The 37 replies with which we are familiar include the states with the largest number of Independent telephone exchanges.

Of these 37 state commissions, 28 recommended that there should be exempted from the law, telephone exchanges of up to 1,000 telephones or 1,000 subscribers, or more. A number of them specified that if telephones are used as the basis, they should include only town telephones—and exclude rural telephones.

One commission recommended an exemption of 800 telephones; one recommended 750; three recommended 500, but with the reservation, in some cases, that such an exemption would be suitable for their particular states—they could not speak for other states. (These were states in which the number and size of exchanges are small.)

The other recommendations were based on population or revenues and are not (because of the great difference between telephones, population and revenue in different parts of the country) easily comparable with the foregoing recommendations.

From all this we have a reasonably comprehensive picture of what the regulatory bodies of these states —not the telephone people—think about this situation. Further, a number of these regulatory bodies have explained, in long letters to Mr. Andrews or Mr. Daugherty, why they think this way about the situation.

These opinions, we repeat, are opinions of governmental agencies that have long been acquainted with the telephone business. They are the opinions of governmental agencies that have been regulating—not operating—the business. They are, in addition, the opinions of agencies that know the telephone business as well, in a large number of cases, as telephone people themselves. They are the opinions of governmental agencies that have the responsibility of representing the public served as well as the investors in, and the management of, telephone companies.

There is a thing known as the "preponderance of evidence." It will be interesting to see how Administrator Andrews and his organization deal with this preponderance of evidence. The manner in which they deal with this evidence will, it seems to us, answer any question as to whether Mr. Andrews is more interested in retaining telephone exchanges under his control, rightly or wrongly, or whether he is more interested in dealing with this situation on the basis of facts.

National Association Committee on Wage-Hour Law

THE WAGE-HOUR committee of the United States Independent Telephone Association, meeting in Washington March 21, issued the following statement:

"This committee and the national association are not opposing the purpose of the national Wage-Hour law. We are doing everything we can to make possible the payment of liberal wages, and the working of reasonable hours, in the Independent telephone industry; and also, specifically and particularly, to make possible the maintenance of employment in the industry.

Everyone—employer or employe—engaged in the industry, knows that there is a 'ceiling' to rates that can be obtained for telephone service in rural sections and small towns; that if rates are raised beyond that point, we lose telephones; that if we lose telephones, fewer people will be needed in the business.

Everyone also knows that the alternative to wages and hours the Independent industry cannot meet, is mechanization of the business; and this certainly means a reduction in the number of employes in the business. Thirty cents or 40 cents an hour and a maximum of 40 hours work a week are of no benefit to the worker who, because of these requirements, has no job.

This committee recommends that every Independent company or exchange which can do so, meet the requirements of the law. It states, however, that in its opinion it is detrimental to employes, to the public served, and also to the telephone industry, to meet the requirements of the law by curtailing the service rendered —such as by eliminating night, Sunday and holiday service, and so on—or by refusing to handle interstate toll calls, or by other makeshift devices which destroy, in one way or another, the value and efficiency of Independent telephony.

These steps will inevitably mean a loss of present telephones, stoppage of the growth of the Independent industry, and a serious reduction in employment in the industry.

The committee believes that this law was enacted (no doubt inadvertently) without due consideration of the situation of the Independent telephone industry, which is regulated now by governmental agencies; which should and wants to operate 24 hours daily, and which performs an essential service in more than 12,000 communities of the United States.

Many members of Congress have now seen and admitted that something must be done, and quickly, to preserve small Independent exchanges; a number of them have said that the telephone business was not intended to be under this law. This committee is merely trying to rectify, as nearly as possible, the situation in which these Independent exchanges have been placed. It feels that unless this situation is rectified, employment in the Independent industry will be greatly lessened very soon.

This committee, we repeat, is not opposing liberal wages and fair working hours for telephone employes. It is, however, opposing a situation which will, unless it is corrected, severely reduce employment in small telephone exchanges. Wages and short hours fixed by law are of no value to the worker who has no job."

Boys Take in Nickels— Officials Develop Headaches

It is a little racket right now but to Chicago officials of the Illinois Bell Telephone Co. it is a big headache. Everett E. Friganza, of the Illinois Bell, recently told how scores of small boys have collected thousands of nickels through the use of a new pay telephone scheme.

In this newest plan, each boy has a number of pay telephones which he visits almost hourly. Each time the boy removes from the coin-return chute of the pay telephone a small piece of cardboard; and he takes out as many as six slugs or nickels. These were returned by the operator due to busy numbers but the calling parties failed to receive them because of the piece of cardboard. This was cleverly folded and deftly inserted into the coin-return chute and prevented the coins and the slugs from falling out of the chute.

The boy, upon removing the coins and slugs, pockets the coins and cashes the slugs in the establishment in which the telephone is located and then goes on to his next call. So the company's ways and means committee is working out a solution for this "boy" problem.

FATHERS AND SONS

CHARLES J. WOPAT, assistant secretary and auditor of the Missouri Telephone Co., Columbia, Mo., had his son, **GEORGE W.,** associated with him at Columbia for nearly eight years. George is now manager for the Automatic Home Telephone Co., at Pontiac, Ill.

Although born in New York City (October 20, 1883), CHARLES J. WOPAT has spent most of his life in the Middle West. He was educated at the University of South Dakota and the Business Normal College at Grand Island, Neb. After teaching commercial and accounting courses at the latter institution and after eight years in the mercantile business, Mr. Wopat entered the employ of the Kansas City Home Telephone Co., Kansas City, Mo., in May, 1920.

Less than two years later he was promoted to the post of supervisor. In the summer of 1928 he left the Kansas City company to become accountant for the Telephone System & Accounting Co. He continued in this connection until April, 1932, when he was made auditor for the Missouri Telephone Co., at Columbia, Mo. Since October, 1935, he has served as assistant secretary as well as auditor of the company.

Mr. Wopat is a member of the Independent Telephone Pioneer Association of the United States, the Masonic lodge and the Columbia Country Club. Collecting postage stamps is his hobby.

GEORGE W. WOPAT, who is 30 years of age, is a graduate of the school of engineering of the University of Missouri. He was employed as switchman for the Missouri Telephone Co., at Columbia, Mo., from the fall of 1929 until the spring of 1937 when he was made manager of the Automatic Home Telephone Co., at Pontiac, Ill., in which connection he is at present serving.

CHARLES J. WOPAT, assistant secretary and auditor, Missouri Union Telephone Co., Columbia Mo., after teaching and mercantile experience, entered the telephone field in 1920.

GEORGE W. WOPAT, a graduate of the University of Missouri, is manager of the Automatic Home Telephone Co., Pontiac, Ill. He has had nearly 10 years of telephone experience.

J. W. ADMIRE (right) manager of the Council Grove Mutual Telephone Co., Council Grove, Iowa, and his son, BUFORD, his right hand man for the past 10 years. The younger man knows the plant end of the business from A to Z, his father testifies.

J. W. ADMIRE and his son, **BUFORD,** who together operate the Council Grove Mutual Telephone Co., of Council Grove, Kans., have worked together for the last 10 years. J. W. ADMIRE has been in the telephone business for the last 35 years. He began his telephone career with the Austin Inland Telephone Co. at Amsterdam, Mo. After he had been with that company about four years he was made wire chief for the Kansas City Long Distance Telephone Co. at Excelsior Springs, Mo.

Some time later he became shopman for the Northeast Kansas Telephone Co. at Hiawatha, Kans. From that position he was promoted to plant superintendent. When the world war broke out Mr. Admire went to Auburn, Neb., to take charge of the Auburn Telephone Co. and to fill a place left vacant by the call to service of the company's superintendent.

Later taking up work on the road, Mr. Admire was engaged for a time in installing central office equip-

HERE IS THE TWELFTH article in a series introducing tomorrow's potential leaders to one another and to the field in general. Material for this feature is most welcome.

in the Independent telephone industry

ment and rebuilding plants. His work included cable work of all types. In 1927 he installed the new cable plant at Kahoka, Mo., for the Middle States Telephone Co. and worked on the installation of the new common battery switchboard and cut the plant into service.

In the spring of 1929 he was called to Council Grove, Kans., to take care of the work of restoring service for the Council Grove Mutual Telephone Co., a recently-installed cable having been submerged when the Neosho River, running through the center of the town, went on a rampage. When he had finished this emergency task he was asked to take charge as manager. This he did, on June 1, 1929.

With the cooperation of the officers of the company, he converted the system to full metallic, rebuilt the rural lines and improved service generally. At that time there were two exchanges in the town of Council Grove, one of them operated by the Southwestern Bell Telephone Co.

After seven years of tireless effort Mr. Admire—with the assistance and cooperation of President G. W. Coffin—was able to effect the purchase of the local Bell plant, and merge the properties of the two companies. Immediately thereafter the company made arrangements to purchase and install common battery switchboard equipment. The new plant, installed in a completely modernized building, was cut into service January 1, 1937.

During the past ten years Mr. Admire has acquired enough stock in the company so that he and Mr. Coffin together own about 80 per cent of it. They now have an exchange serving about 1,000 stations which is one of the most modern and best-operated in Kansas.

BUFORD ADMIRE was born in Adrian, Mo., May 16, 1909. After finishing high school, he entered college. At that time he was living in Tarkio, Mo. When his father took charge of the Council Grove plant and needed someone to help him, Buford decided he would rather join his father in the telephone business than finish college. Thus after only one year of college, he went to work under his father.

He was taught all phases of plant work by his father and he now handles it in a very capable manner. He has been a faithful helper for his father in the past 10 years and, according to his father, knows the plant end of the telephone business from A to Z. Since they are financially interested in the business, it makes a combination that no one could better accomplish than father and son.

CHRISTIAN E. EABY, vice-president, general manager and director of the Denver & Ephrata Telephone & Telegraph Co., Ephrata, Pa., has associated with him in the telephone business not only his son, **DAVID R.,** but the latter's twin sister, Elizabeth F. "Betty," as she is generally known, worked as operator during her vacations from the Ephrata high school. After graduating, in 1936, she was for a time employed as a full-time operator; now, however, she is employed in the commercial department.

DAVID also worked for the Ephrata company during his vacations from high school. After graduating in the same class with his twin sister, he commenced working in the plant department to learn the

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CHRISTIAN E. EABY, vice-president, general manager and director of the Denver & Ephrata Telephone & Telegraph Co., Ephrata, Pa. His son, DAVID R., is associated with him as clerk in the plant department.

Commission and Court Activities

Nebraska Manager Announces He Will Metallicize Lines

E. H. Towle, manager of the Southeast Nebraska Telephone Co., Falls City, has informed the Nebraska State Railway Commission and his subscribers that he does not intend to litigate with the Eastern Nebraska Public Power District over the large development of rural power construction the district has planned. With the districts denied the right to use any part of a government loan in paying for damage to grounded telephone lines, it is a question of either allowing the farmers full opportunity to get service or tie up power development by insisting that the commission make approval of applications conditional upon payment of cost of metalicizing telephone lines.

Mr. Towle believes, as do some other telephone managers, that farmer goodwill is helped by refusing to throw barriers to their access to power, and so he is preparing to rebuild his lines wherever necessary rather than keep out rural power lines. He says it will be necessary to metallicize 680 miles of rural lines if the government project is completed. After that is done he proposes to ask the commission to increase rates in an amount sufficient to take care of the increased investment and maintenance costs.

The commission has found that in cases where disputes have arisen, there is a disposition on the part of farmers involved to consent to an increase in telephone rates if matters can be arranged so that they may retain telephone service and also get electric service. It remains to be seen whether they will pay for both services.

Under conditions that have existed for the last five years many farmers have discontinued telephone service costing them in many cases less than a dollar a month when served by farm mutuals for the reason they could not afford to continue. The least they can get electric service for is $3.50 a month, and rural power district managers say many who first signed have never taken power service since it has been made available.

▼ ▼

Action on Telephone Bills by Washington Legislature

During its closing week the house of the Washington state legislature blocked action on a senate bill to facilitate the financing of public utility districts, while the senate killed a house bill that would put the burden of cost of eliminating interference with telephone service upon the extension of rural power lines.

The legislature completed action on two other regulatory laws: (1) A bill providing for the expansion of the investigatory powers of the state commission at the expense of the utilities; (2) a bill providing for the appropriation of $300,000 for a state-wide telephone rate investigation.

▼ ▼

Discontinuance of Handset Charge After 18 Months' Use

The Northwestern Bell Telephone Co. has been directed by the Nebraska State Railway Commission to discontinue its charge of 10 cents a month for handsets in place and used for 18 months on and after January 1, 1940. In November, 1937, the commission, after a conference with the company, reduced the surcharge from 15 cents to 10 cents, such charge to continue until 18 months after the installation of a handset substituted for a wall or desk set and be in addition to certain change charges prescribed at the time of the substitution.

Since then the commission has had additional conferences with officials of the company looking towards final discontinuance of the charge. It finds that a large percentage of handset subscribers have by now paid out on this handset charge; hence the number of substitutions incident to the change of instruments has been minimized to a large extent. It, therefore, appears that a definite announcement of the elimination of the monthly charge should be made at this time and that the order be so framed as not to create an excessive, concentrated demand on the company for this type of set.

▼ ▼

Rate Revisions for Six Exchanges of Ohio Bell

There being no objections filed, the Ohio Public Utilities Commission, on March 10, authorized the Ohio Bell Telephone Co. to revise its rentals after conversion of equipment from magneto to the dial common battery service at the following rates in the following exchanges:

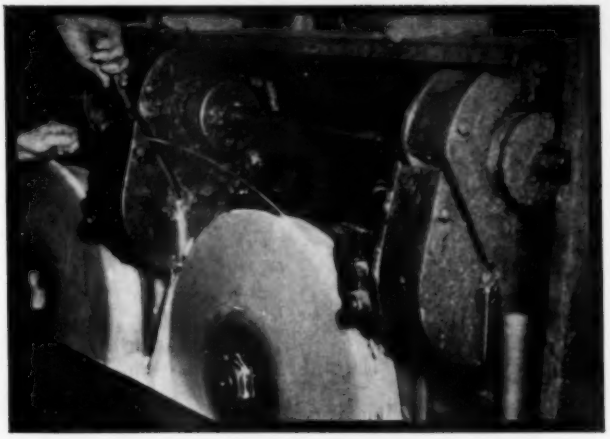
Salineville — Residence independent, $2.50 to $2.75; residence four-party, $1.75 to $2.00; residence rural, $1.75 to $2.00. No change is made in the independent business line rate of $3.50, the business two-party rate of $3 or the business rural rate of $3.

Chesterland—Business independent, $3.00 to $3.50; business two-party, $2.25 to $3.00; business rural, $1.75 to $3.00; residence independent, $2.75 to $2.75; residence four-party (new), $2.00; residence rural, $1.75 to $2.00.

West Lafayette—Business independent, $4.00 to $5.50; business two-party, (new) $4.50; residence independent, $2.75 to $2.75. No change is made in the business rural rate of $3.50, the four-party residence rate of $2 or the residence rural rate of $2.

Conesville — Business independent, $4.00 to $5.50; business two-party, (new) $4.50; residence rural, $2.00. No change is made in the business rural rate of $3.50, the four-party residence rate of $2, the residence independent

(Please turn to page 30)



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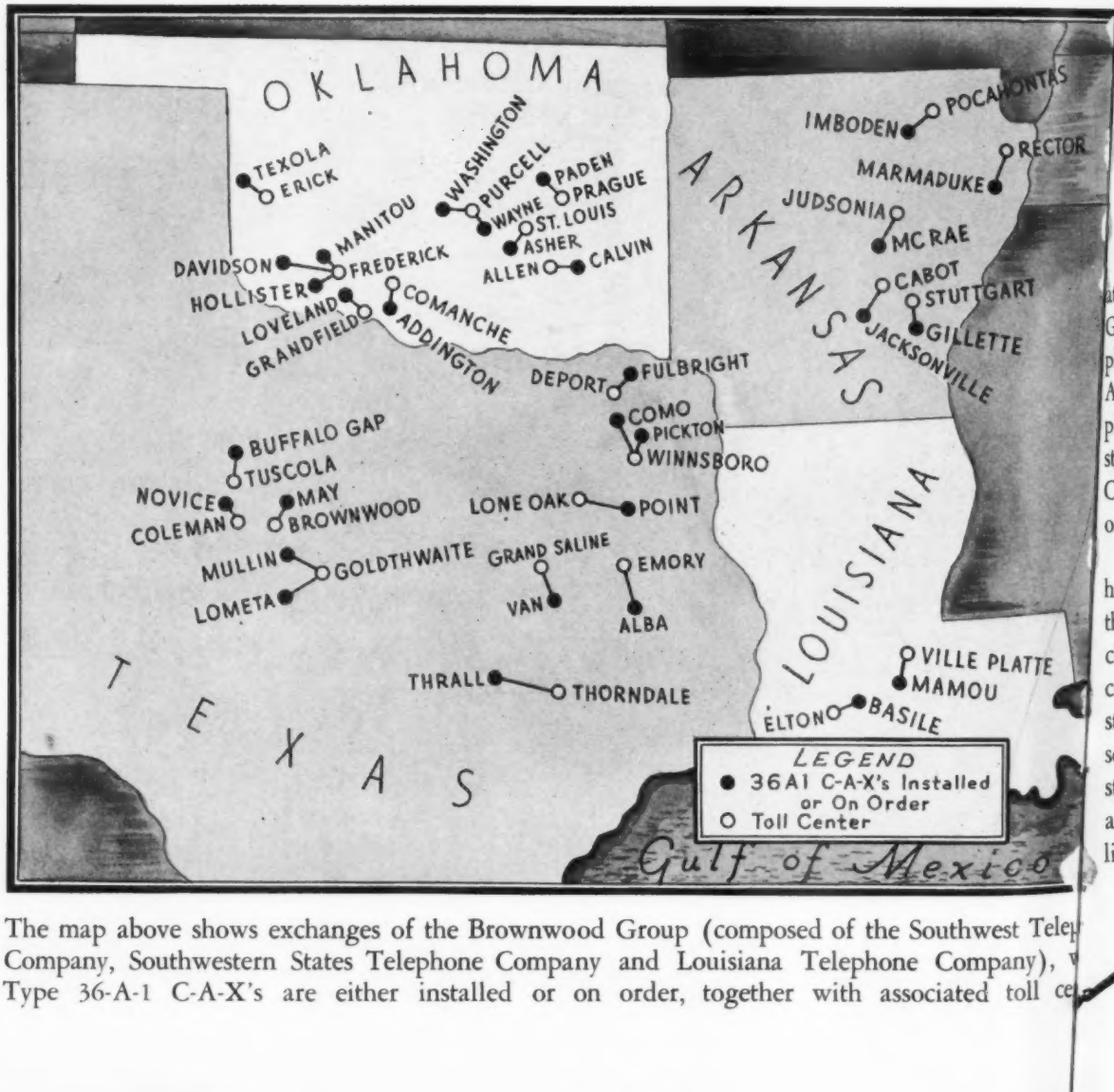
OPERATING GROUP TWENTY



The map above shows exchanges of the Brownwood Group (composed of the Southwest Telep Company, Southwestern States Telephone Company and Louisiana Telephone Company), w Type 36-A-1 C-A-X's are either installed or on order, together with associated toll ce

lectric News ★★★

ued onally *Number I*

P DERS
TYNE 36-A-1 C-A-X's!

ROWNWOOD GROUP OF OPERATING COMPANIES PLANS ULTIMATELY TO CONVERT MAJORITY OF ITS SMALL EXCHANGES TO AUTOMATIC OPERATION

Here's news for every owner or operator of a small exchange! The Brownwood Group of operating companies has recently placed orders for twenty-nine Type 36-A-1 Automatic Electric C-A-X's, with more planned for future installation. This constitutes one of the largest orders for C-A-X's ever placed by an operating organization!

Scores of other operating companies have adopted the Type 36-A-1 C-A-X as the ideal equipment for their small exchanges. Specifically designed for application to exchanges of less than 100 stations, its nominal capacity is 19 subscriber lines (with a maximum of ten stations per line), four conversation links and three trunks. Reverting calls on party lines do not tie up links, so four such links are usually ample for a board of this size. Dial tone, busy tone, ring back tone and identity tone for pay-station service are provided. Either code or harmonic ringing can be furnished, with automatic ringing and quick ring cut off when the called subscriber answers. Faulty lines are automatically locked out after a predetermined time interval.

These are but a few of the service features that the Type 36-A-1 C-A-X brings to small exchange telephone users. The advanced design and high quality construction of this board mean long, trouble-free life with sure yearly operating profits for the telephone company. Write for complete information concerning the operating advantages of this modern board for the small exchange — sent promptly upon request.

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in the Nation's Capital

by Francis X. Welch

Special Washington, D. C., Correspondent for TELEPHONY

HOUSE COMMITTEE starts activity on Wage-Hour Act Amendment . . . Action of the FCC in revising its general order No. 19 is of much significance to telephone industry . . . FCC is not disposed to allow use of air waves between points where land lines or cables are available . . . President is in somewhat of a dilemma in appointment of FCC member to succeed Commissioner Sykes

LAST WEEK the spotlight on wage-hour amendments shifted suddenly from the Senate to the House of Representatives. This development came without much notice, even to close followers of the Herring-Harrington bills, and was probably prompted by forces operating within the Wage-Hour Administration.

Just why the Wage-Hour Administration prefers to have the House committee on labor consider amendments to the Wage-Hour Bill rather than the Senate committee on education and labor is not presently apparent. However, as a result of the switch, the hearings before the Senate committee, for which the United States Independent Telephone Association was negotiating, during the latter part of March will perhaps not develop unless the House committee handles the matter unsatisfactorily.

For legislation of this type, Congress does not often hold duplicate committee hearings in both branches. It's generally a question of which branch picks the matter up first—after that the other branch waits for its companion to complete action.

AS FAR AS the outlook for some legislation for the relief of the small telephone exchange at this session is concerned, this shift of emphasis from the Senate to the House does not cloud the picture at all. If anything, the chances are somewhat improved by the fact that Chairman Norton of the House committee has taken such an active personal interest in the matter.

After all, it is immaterial to the Independent telephone industry which branch of Congress makes the kick-off. The important thing right now is to get the ball rolling. These bills will never get anywhere waiting on the sidelines.

Things are moving so fast on this proposition that these lines may be somewhat out of date before they appear in print, but, at this writing, it seemed likely that Chairman Norton would introduce her own bill covering various amendments to the Wage-Hour law on or about March 24. The House labor committee at a meeting on March 22 was to have considered a report from the Wage-Hour Administration dealing with this subject—among other things, the troubles of the small telephone exchanges. On the basis of this meeting, Chairman Norton ordered the drafting of an omnibus amendment bill which she would introduce on behalf of the committee.

If everything goes off according to schedule, the "Norton Bill" ought to get to hearings about the first week of April and be reported on the floor of the House for action before the end of that month.

There is considerable danger, however, that the Norton bill may not afford as comprehensive relief for the small telephone companies as is provided in the Herring-Harrington bills. This is probably because the Wage-Hour Administration had such a leading hand in the preliminaries.

It is no secret that certain officials of the Wage-Hour Administration think that the proposed 1,000-subscriber exemption for telephone exchanges is broader than necessary. They would like to cut it down substantially. For that reason, Chairman Norton's bill, when it appears in original form, may only offer exemptions for considerably less than 1,000-subscriber exchanges. However, by the time you read these lines, you may already know the facts from the press report of the bill itself.

Even if Chairman Norton does try to whittle down the exemption, there is still the chance that the committee may raise it by subsequent amendment before it is ready for a House vote. The principal consideration right now is that some progress on legislation for the relief of the Independent telephone industry seems to be apparently under way. That, of itself, is good news.

THE FCC took a rather important action last week when it revised its general order No. 19, which was originally proclaimed on October 13, 1937. The details of the latest order has to do with the allocation of the ultra high frequencies of the radio spectrum. It may sound very technical and of little significance for the telephone industry. But it is significant just the same.

The significance lies in what was said in the opinion accompanying the order rather than in the details or mechanics of the order itself. To cover the latter briefly, the commission rearranged the allocation of the ultra high frequencies as follows:

(1) Fixed point-to-point com-

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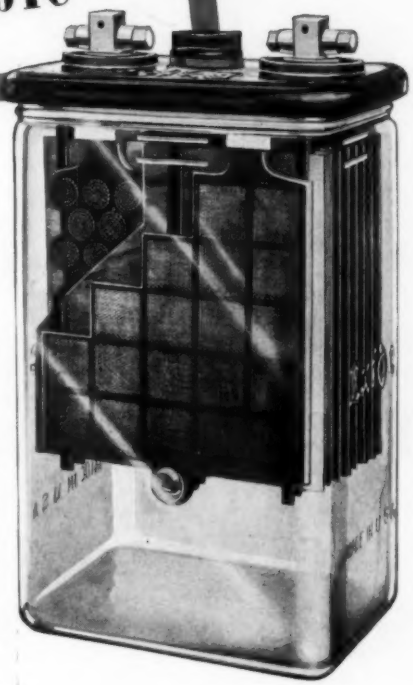

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munications services got seven new channels; (2) aviation got 19 additional frequencies because recent radio improvements have demonstrated that the ultra high frequencies give virtually staticless performance which is vitally important for the safety of aviation; (3) television gets the same 12 channels above 150,000 kilocycles that were reserved before under the 1937 order (plus seven additional channels in the 40,000 to 150,000 range), with the new limitation that three of these channels will be open to general experimentation.

So much for the details. It is the policy pronouncements that should make the telephone industry sit up and take notice. The FCC was discussing the claims of the fixed point-to-point services for space on the spectrum. These are the services which use the air waves for communication between fixed locations (such as between New Orleans and Atlanta).

Obviously, such communications could just as well be conducted over telephone wires or telegraph wires in cases where such land line services are already established. True, there are cases—such as transoceanic communication or service to remote land points, such as Alaska — where radio communications are necessary. There are also emergency and military situations which must be borne in mind.

By and large, however, the FCC entered a reassuring opinion that it was not disposed to allow needless use of the air waves where land lines or cables are available for service. The commission said on this point:

"The fixed service needs, concerning which much of interest appears in this record, are principally directed to domestic uses not necessarily dependent upon radio for their existence and for the most part not for purposes entailing greatly disproportionate costs if provided by wire lines. These uses would be chiefly to supplant existing wire facilities which have not been shown to be inadequate.

"It is the commission's judgment, therefore, that provision for the fixed services in the frequency range considered must be limited, generally, to circumstances where wire lines are not available or where the cost of wire facilities is greatly disproportionate, as under conditions where circuitous wiring would be necessary."

If the FCC sticks to this policy over the long range (and there are no indications to the contrary), that is the best news which has come out of Washington for the telephone business for a long time. And don't rush off with the idea that the FCC has taken this attitude because of any sudden love or sympathy for the wire utilities. Rather it is because of the FCC's desire to "conserve the spectrum."

IN THIS attitude there is really nothing new. Well-informed radio engineers have realized for years that the mystic band, known as the radio spectrum, is a precious national heritage. There is just so much of it which we can use; and we must not only allocate it in orderly fashion among our various domestic claimants for rights on the air, but we must share it equitably with foreign nations who also live in this world of ours.

True, it seems that every day new discoveries come to light for stretching the spectrum and utilizing portions of it which were not useful before. But it is also true that for every new figurative inch on the ultra short end of the spectrum which radio science reclaims, increased commercial and social pressure demands two inches for utilization. The FCC is the guardian of this heritage, and it is acting wisely in parceling it out with care and precision.

There may come a day, sooner than we expect, when the FCC will have to take the drastic step of throwing off the air some services which are already there, to make room for vitally necessary radio service, such as military, aircraft, or maritime, whose mobile character makes wireless communication indispensable. When that day comes, the telephone industry, with its land lines waiting on the ground, has a good chance to pick up some new business that the FCC may have to knock out of the air.

While we are on this subject of radio spectrum usage, another passage from the FCC order of March 13 may be of interest. It concerns television. The opinion said in part:

"There remain for consideration above 150,000 kc. the assignments to television. It is generally conceded that these bands are not in excess of minimum requirements should the service develop in accordance with present expectations. However, it is strongly urged that in the present state of development, knowledge is lacking upon which to predicate a definite allocation of these bands to the virtual exclusion of other experimental services.

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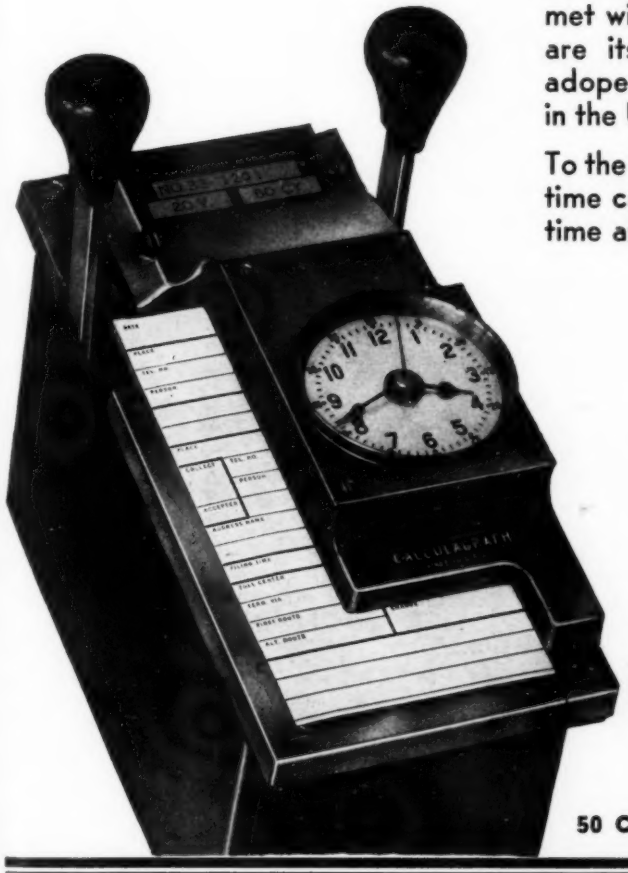

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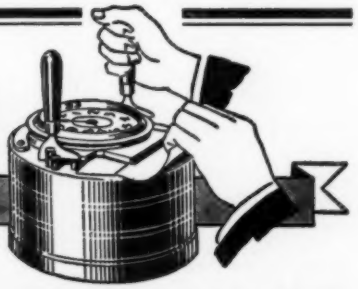

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In considering this matter, the commission cannot put aside its responsibility to make provision for the future uses and adaptabilities of the radio medium. Television is an extension of the radio art which, by its very nature, requires planning. The inherent structural vastness of this service, requiring wide bands of emission and protection from interference, even during experimental operations, makes this essential.

If other services be permitted to absorb the available frequencies because of a lack of assured present development, to displace them upon the technical maturity and public acceptance of television would be of great hardship and difficulty and it might then even be impossible to permit entry of that service.

That television represents an advancement of the radio art of importance and value to the public is undisputed. Nor is it seriously contended that the service may be rendered in any practical manner by any means other than radio."

It is apparent that the FCC is striving to keep itself from being "frozen and strait-jacketed" by too rigid standards at this still early state of development in that art.

AS FOR the FCC itself, the members seemed to be taking it for granted that the commission will go along as presently constituted for at least another year. This probably means that President Roosevelt will not delay in naming a successor to Commissioner Sykes, whose resignation takes effect on April 1.

The reason why it is necessary for the President to fill the commission's membership is to ensure the retention of control by Chairman McNinch which has heretofore rested on a very slim margin. Names for the successor to Commissioner Sykes are flying around Washington furiously. It has become almost a guessing contest.

Former Representative David J. Lewis of Maryland is still a favorite, although handicapped somewhat by the fact that he comes from an eastern state. At present the East is over-represented on the commission. If the appointment is made on a geographical basis, the President will probably pick someone from the South (Commissioner Sykes is from Mississippi) or the West. For the same geographical reason, former Senator Brown of New Hampshire also seems to be trailing as a possibility.

Your correspondent won't attempt to list all the new names because it is doubtful if there is any factual basis for any of them. One more or less bizarre suggestion was for a lady commissioner—former Representative Nan Honeyman of Oregon, whose principal qualification seems to be that she comes from the West.

This appointment of a successor to Commissioner Sykes is somewhat of a dilemma for President Roosevelt because if he appoints a 100 per cent New Dealer to insure support for Chairman McNinch, he may run counter to his current "business appeasement" motif. On the contrary, if he picks a conservative for the job, the new appointee may line up with Commissioner Craven and take the control out of the hands of Chairman McNinch on fundamental policies.

One solution might be to elevate a deserving member of the staff who would not be opposed from any direction. Chief Engineer Jett and Assistant Chief Engineer Webster are both able men and universally liked inside and outside of the commission. However, it does not seem to be in the nature of things for the FCC membership to become career appointments. They will probably continue on a political basis.

▼ ▼

Arrangements Under Way for Nebraska Convention

Secretary George M. Kloidy, of the Nebraska Telephone Association, reports that while complete arrangements have not yet been made for the annual convention to be held in Hotel Lincoln, Lincoln, Neb., April 11 and 12, enough has been outlined to justify the belief that it will be one of the most interesting and instructive meetings in recent years.

One of the big discussions of the convention will concern itself with the national wage and hour law and possibly the state proposal, which has not yet been ironed out in the legislature.

▼ ▼

Radiotelephone Now Reaches Newfoundland

The establishment in January of a radiotelephone circuit between Montreal, Ontario, Can., and St. Johns, Newfoundland, provides a voice link between the island and the North American mainland. The new channel employs short waves over a distance of nearly 1,000 miles. Through Montreal, it links all Bell and Bell-connecting telephones with the principal cities of Newfoundland.

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In general people prefer to make long distance calls at the telephone exchange. We believe, therefore, that it is an advantage wherever possible to provide a pay station and twenty-four hours' service at the telephone exchange office.

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land, has a population of about 285,000, and approximately 12,000 telephones. The opening of the new radiotelephone circuit between Montreal and St. John's recalled an important early experiment in radiotelegraphy; for it was at St. John's, in 1901, that Guglielmo Marconi received a radio signal transmitted from Cornwall, England, and thus demonstrated the practicability of "wireless" for communicating across the ocean.

The Operators' Corner

By MAYME WORKMAN

Traffic Supervisor, The Illinois Telephone Association, Springfield, Ill.

CALLING PARTY insists upon being connected with a line which is busy. Series No. 361

AN OPERATOR tests the called line, finds it is busy and passes a busy report to the calling party saying: "The line is busy." The calling party has made several attempts to reach this line and he says: "Central, that's *my* line and I know it's my wife talking. You just break in on that connection and tell her that I want to talk to her."

Does that sound familiar? If the operator follows the correct procedure, she will refer the case to her supervisor or chief operator, who will explain to the calling party that the line he is calling is busy but that she will be glad to call him as soon as it becomes available.

If he insists upon obtaining connection, claiming that the case is one of great urgency, she will request his name and proceed as follows:

(a) If he gives his name, tell him that you will try to obtain permission from the parties using the line to interrupt their conversation in order that he may secure the line. Then interrupt conversation, saying, for example: "This is the supervisor. Mr. Doe desires the 218 line for an urgent call."

If the line is obtained, establish connection for the calling party. If the parties using the line refuse to release it, inform the calling party that such is the case.

(b) If he refuses to give his name, proceed as in (a) but, instead of giving the name of the calling party, advise the parties using the line that the calling party refuses to give his name. Proceed according to instructions received from the parties using the line.

Some companies have established the practice of asking for busy lines in all cases where the calling party insists upon obtaining connection to the called number, if the called line has been busy for a stated period, five minutes, for example. Where this practice is followed, there is always danger of asking for a line that has not been busy for the designated period.

While asking for the busy line will satisfy the calling party, there is always the possibility of incurring the ill will of one or both parties who are carrying on a conversation, particularly if the operator having the connection on her board should err in her judgment as to how long the connection had been established and a request is made for the line before the specified time limit has expired.

Many companies ask for busy lines only in cases of emergency. While it is a source of annoyance and inconvenience to the calling party not to be able to reach his own telephone, after all this is a matter concerning the management of his household. Therefore, it seems the responsibility of controlling the situation rests with him rather than with the telephone company.

Questions from Illinois Operators

1. How do you proceed to cut in on on a busy line?
2. A call is placed station-to-station, number given. The party answering advises he is not ready to talk on call. Is this a chargeable report? If the call is completed later, is it automatically a person-to-person call?
3. When receiving a collect call, is it always necessary to get the number of the calling party?
4. In ringing a party on a local call, how many times should the operator ring before telling the party they do not answer?
5. Is it advisable to list new subscribers on the switchboard for at least a few days?

The answers to these traffic questions are given on page 33.

Fathers and Sons in the Independent Telephone Industry

(Continued from page 17)

telephone business from the bottom up. He is now employed as a clerk in the plant department.

A member of the football and track teams while in high school, David is also an enthusiast in swimming, golfing and hunting.

CHRISTIAN E. EABY was born on a farm in Lancaster county, Pa. —the "Garden Spot of the World," he says—December 17, 1881. At the age of 10 his parents moved to the city of Lancaster, and seven years later he was doing odd jobs at a country club on the outskirts of that city.

In 1899 Harry Witmar, then manager of the Pennsylvania Telephone Co. (now the Bell Telephone Co. of Pennsylvania) said to him: "Chrissie, how would you like to try the telephone business?" To this he replied: "I would like it very much."

Right then and there Mr. Eaby started at the job of digging holes; later he was transferred to the maintenance department and subsequently was employed, successively, as installer, inspector, PBX and testboard man. Wages being very meager in those days, he worked for three years for the trifling remuneration of $15 a month.

Appointed manager of the newly-organized Denver & Ephrata Telephone & Telegraph Co. in 1911, Mr. Eaby was elected a director in 1921; six years later he was made vice-president and general manager.

Mr. Eaby has witnessed the growth of the company from an exchange operating 200 stations to a system of five exchanges and 4,227 telephones. He was active in bringing about the unification of the telephone properties in Lancaster county and supervised the conversion of the system from magneto to common battery operation.

A director of the Pennsylvania Independent Telephone Association and a member of its service committee, Mr. Eaby is also chairman of the board of directors of the Tri-County Telephone Association of Lancaster, Lebanon and Berks counties. He is a member of the Bell Telephone Pioneers of America, as well as the Independent Telephone Pioneer Association of the U. S., the Lions Club, and the local and state chambers of commerce. He is a director of the Ephrata Building & Loan Association, president of the Ephrata Community Chest, and is active in the Boy Scout and Y.M.C.A. organizations.

His hobbies—aside from social welfare work—are hunting and the game of quoits. He was a candidate for the office of state senator in 1936.

Mr. Eaby had another son, Christian B., who after two years' experience in the telephone business, with his father, was killed in an automobile accident in 1932. Mr. Eaby's two brothers, Mark and Paul, are both employed by the Bell Telephone Co. of Pennsylvania in the cable department. The combined service in the telephone industry of the three brothers is 85 years.

Commission and Court Activities

(Continued from page 18)

line rate of $2.75 or the residence rural rate of $2.

Bloomingville and Castalia — Business independent, $4.00 to $5.50; business two-party, $3.50 to $4.00; business rural, $2.50 to $3.00; residence independent, $2.50 to $2.75. The residence four-party rate of $2 remains unchanged. This applies also to the residence rural rate of $2.

▼ ▼

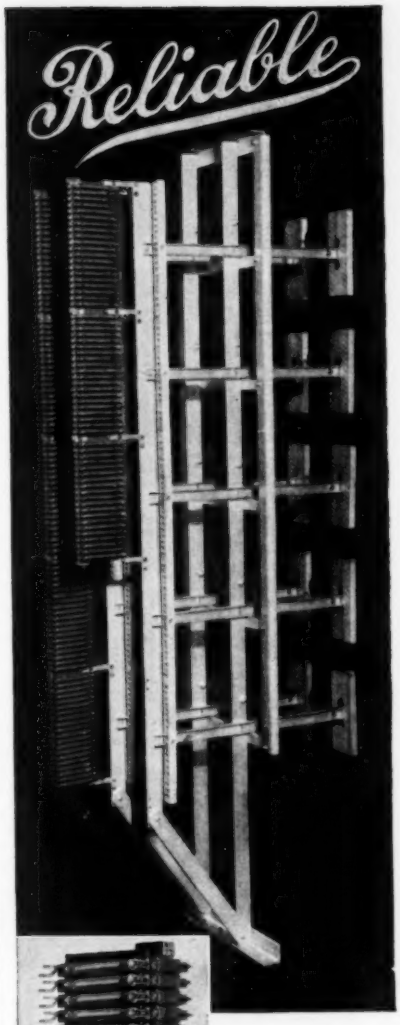
New Rate Schedule Approved For Texola, Okla., Exchange

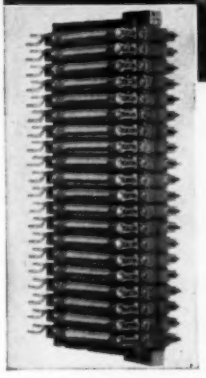
The Oklahoma Corporation Commission, in an order issued February 9, granted authority to the Southwest Telephone Co., to install common battery automatic type equipment and reclassify service and rates at its Texola exchange. The new equipment replaces magneto type service.

Company officials testified at the hearing that for the 12 months ended December 31, 1937, the net loss in the Texola exchange was $491.62.

The new rate schedule, which will become effective after the automatic equipment has been installed and the cutover made, follows:

Two-party business (selective ringing), $3.00 per month; four-party residence (semi-selective ringing), $1.50; business extension, 75 cents; residence extension 50 cents; handset, extra charge 15 cents. The handset extra charge and the residence extension





The simplified design of the protectors gives the highest degree of protection at a low cost per pair.

The heat coil and all moving parts are enclosed in the fuse-like cartridge, free from dust and accidental opening.

MODERN CENTRAL OFFICE PROTECTION

A complete line of standard frames for floor or wall mounting. See our latest catalog for further information or write to us for MDF bulletin.

Reliable ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES
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KLEIN
"Lightweight"
CLIMBERS

Klein "Lightweight" Climbers are built to the minimum weight possible consistent with maximum safety. Every pair is tested exactly the same as are the old time tried Standard Climbers. The lineman can throw his weight on these climbers with confidence —they are Klein's!

DISTRIBUTED THROUGH JOBBERS

Foreign Distributor: International Standard Electric Corp., New York

The four pamphlets listed below will be sent without charge to anyone interested. Check the ones you want:

- ☐ Lightweight Climbers.
- ☐ Specifications on Linemen's Belts and Safety Straps.
- ☐ Klein Kord Fabric Safety Straps.
- ☐ Pocket Tool Guide.

Mathias KLEIN & Sons
Established 1857 Chicago, Ill. U.S.A.
3200 BELMONT AVENUE

rates are the same as in the old schedule.

The business extension rate is reduced 25 cents. The new business and residential monthly rates are the same as were applied under the old one-party business and residential schedules for magneto service.

▼ ▼

User of Public Pay Station in Store Is Invitee

The Nebraska Supreme Court has ruled that a person going into a store to use a pay telephone station, in the proceeds of which the proprietor shares, is a customer and has the legal status of an invitee to whom the storekeeper owed the duty of maintaining his premises in a safe condition. Mrs. Mary Haley of Lincoln had gone into W. C. Deer's beer tavern to place a call, and while there walked to the toilet, located in a dimly-lighted place, and fell down a trapdoor opening. She recovered damages in the amount of $2,400, which the court orders paid.

The court held that the attempted use by her of the toilet facilities of the tavern, in connection with her telephone call, did not change her status as a customer of the place and she is entitled to reasonable damages.

The defendant claimed that her legal status is that of a licensee, one whose presence is not invited but tolerated.

This is the first time the supreme court of Nebraska has ever passed on the question, and in only one other state has a similar decision been rendered. The court said that where one solely for his personal pleasure, convenience or benefit enters upon the premises of another with his consent but without invitation there can be no recovery, but that where one is a customer she is not charged by law with anticipating dangerous and negligent conditions of the premises, but may assume that others have done their duty to give proper warning of hidden dangers.

▼ ▼

Rate Fixed by Commission Becomes Legal Rate

The Nebraska Supreme Court held recently that after the Nebraska State Railway Commission has fixed a rate for a public utility it becomes the legal rate because action by the commission has all the force and effect of a legislative statute. It cannot later, after the utility has collected the money, order a part of the money returned on the ground that the rate it had established previously was unreasonably high or unduly discriminatory.

The case, a test one, involved claims of livestock shippers against all Nebraska railroads totaling $175,000, brought under a reparations statute. The court says that when a utility collects lawfully established rates, the money belongs to it and that no law can take it out of its pocket without violating the due process clause.

Failure to appeal by the railroads was held not to have estopped them from denying liability, since the order was null and void from the beginning.

▼ ▼

Increase Approved for Newark (Ohio) Telephone Co.

Upon showing made by the Newark (Ohio) Telephone Co. that approximately all of its subscribers have agreed to the change, the Ohio Public Utilities Commission, on March 6, authorized the company to charge the following rates in its Gratiot exchange, effective upon substitution of automatic for the present magneto service:

Business, independent line, $2.75 to $4.25; business four-party, $2.25 to $3.25; business rural, $2.25 to $3.25; residence independent, $2.75 to $3.25; residence four-party, $1.75 to $2.25; residence rural, $1.75 to $2.25.

▼ ▼

Central Office Equipment Taxable as Real Property

New York Supreme Court Justice Frank J. Cregg, of Syracuse, ruled recently that the central office equipment of the New York Telephone Co., in its Montgomery street building in Syracuse, is taxable as real property. The decision states, in part:

"The court adopts the report of the referee that the central office telephone equipment is taxable as real property under the provisions of the tax law.

"On motion of respondents an order confirming the referee's findings of fact and conclusions of law may be entered and judgment granted respondents with costs and referee's fees of $3,400. Petitioner's motion for judgment that the central office telephone equipment is not taxable as real property is denied without costs."

▼ ▼

North Carolina Rural Telephone Authority Bill Killed

The public utilities committee of the House of the North Carolina legislature on March 7 voted to report unfavorably H.B. 517 which would provide for a rural telephone survey by the Rural Electrification Authority and promote and encourage extending telephone lines in rural communities.

Dudley Bagley, state REA chairman, and telephone companies' representative spoke against the bill while Harry Caldwell, master of the state grange, favored it.

New Rates for Middletown, O., Approved by the Commission

The Ohio Public Utilities Commission, on March 8, authorized the Ohio Bell Telephone Co. to file a new local exchange schedule for Middletown. The new tariff adds to the base rate area certain territory in which has arisen demand for base rate area service and creates six zone areas wherein the base rate area service is not available except at base rate rentals, plus standard extra mileage rates and hereafter will be furnished at the following rentals:

Business independent line, $6.60; business two-party, $5.65; residence independent, $3.60; residence two-party, $2.90; residence four-party, $2.25.

▼ ▼

Truck Hits Fallen Pole; Company Not Liable

A jury in the circuit court of Callaway County, Missouri, after only five minutes of deliberation, returned a verdict March 7 in favor of Frank Holland, defendant in a $1,000 damage suit brought by C. J. Hoffman, of Kansas City, Mo.

Mr. Hoffman, in his petition, alleged that his truck struck a telephone pole belonging to Mr. Holland's company, the Auxvasse Telephone Exchange, Auxvasse, Mo., on the night of January 8, 1937, after the pole had fallen across Highway 54.

The defense based its case on the fact that ice and sleet had caused the pole to break and fall across the highway, an act for which the defendant could not be held responsible, and that Mr. Holland had the pole removed as soon as he was notified.

▼ ▼

Directory Error Non-Liability Ordered from Schedules

Nine telephone companies in New York state were ordered by the New York Public Service Commission, March 17, to stop "attempting" to escape liability for erroneous listings in telephone directories.

The commission directed the companies, including the New York Telephone Co., to remove from their tariff schedules provisions which the commission said sought to relieve them of liability arising from negligence or misconduct of officers, agents or employes

Good Measure

By ANNE BARNES

Traveling Chief Operator, Iowa Independent Telephone Association, Des Moines, Iowa

"JOY, TEMPERANCE, and repose, slam the door on the doctor's nose." This quotation from Longfellow is really a doctor's prescription. It is the one our doctor gives us, as good measure, in addition to his other counsel and service. The latter, you pay for; the good measure part is free.

Nine times out of ten, if we follow the free part of the prescription, we will be cured sooner of whatever ails us. But the doctor knows we won't follow it—and we don't.

Let us try to analyze the three healing properties in the prescription: joy, temperance, and repose.

JOY: Look on the bright side of life; be cheerful, optimistic. Joy is the stimulant so necessary whether we are sick or well.

TEMPERANCE: Be moderate in eating, drinking; and rest sufficiently. Temperance in these three things keeps the head clear, the blood and digestion in normal condition.

REPOSE: How nature responds to sufficient habitual rest! Repose is the foster-nurse that urges us to relax to its soothing ministrations. When we stop to consider, the doctor makes a pretty good living at our expense. If our company provides us with sick benefit protection, the doctor is still better off. But does that mean we should take unnecessary risks, when somebody else pays the doctor bill?

If we are careless about our health, we become not only a liability to our company—which pays for our sick benefit protection—but also to our public, which often has to put up with *make-do* service while we are off on sick leave.

MORAL: "Health is the greatest of all possessions; a pale cobbler is better than a sick king."

SANDS

TYPE 40 PROTECTED CABLE TERMINAL

A compact, small-capacity unit arranged for pole or wall mounting. The reversible zinc cover allows cable to be led from top or bottom. Each pair of protectors consists of two Type 17, 5-ampere wood fuses and two Type 2105 discharge blocks. Available in capacities of 3, 5 and 7 pairs. Information on this and other Sands protective equipment gladly supplied upon request.

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AUTOMATIC ELECTRIC SALES COMPANY, LTD.
Chicago

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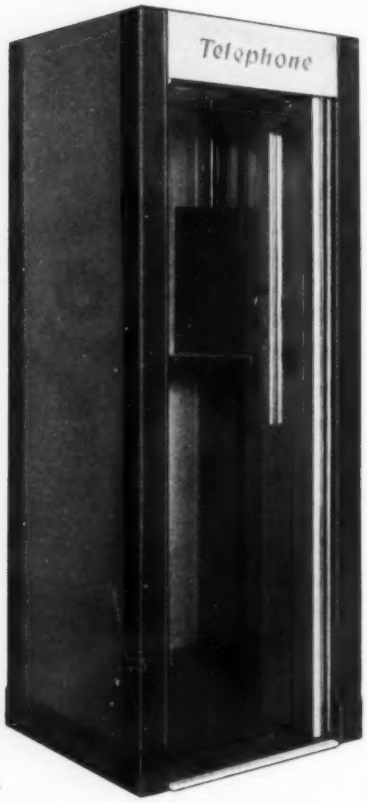
STEEL

it serves and survives



A New "LOW" in COST

A New "HIGH" in REVENUE

A new booth at a low cost making available to telephone companies a high revenue never before possible. Write for descriptive circular and information.

SHERRON METALLIC CORPORATION

1201 Flushing Avenue, Brooklyn, N. Y.

National Distributors and Sales Agents
J. H. BUNNELL & COMPANY
215 Fulton Street, New York, N. Y.

in connection with errors or omissions. Courts have ruled that the companies are liable for such damages, the commission stated.

The commission order provides that changes in the tariff schedules must be made by April 1.

In addition to the New York Telephone Co., the order affects the Chenango & Unadilla Telephone Corp., Highland Telephone Co., Jamestown Telephone Corp., Orange County Telephone Co., Oswego County Independent Telephone Co., Rochester Telephone Corp., Tri-State Associated Telephone Corp., and the Upstate Telephone Corp. of New York.

The tariffs of the New York Telephone Co. do not include any provision attempting to relieve it of liability for errors or omissions in its directories, according to a statement issued by the company.

"The company has never assumed that it would avoid liability for injuries caused by directory errors or omissions where gross negligence or wilful misconduct on its part was shown," the statement said.

Summary of Commission Rulings and Hearings

Federal Communications Commission

March 6: The Southwestern Bell Telephone Co. filed application for construction permit for a new coastal harbor telephone station at Galveston, Texas, to operate on frequency of 2300 kc with 400 watts power, A2, A3 emission, unlimited time. Station is to be used to provide service to vessels using the ports of Galveston, Houston, Beaumont, Port Arthur, Corpus Christi, Texas, and other ports in the general area.

March 13: The Southern Bell Telephone & Telegraph Co. requested authority to supplement existing facilities between New Orleans and Port Sulphur, La.

March 13: The Chesapeake & Potomac Telephone Co. of Baltimore City, requested authority to supplement existing facilities across the Chesapeake Bay between Sandy Point and Broad Creek, in Maryland.

March 14: Permits granted the Pacific Telephone & Telegraph Co. to construct two new special emergency portable radiotelephone stations to use a frequency of 2726 kc with 50 watts; also granted licenses to cover it. Station is to be used for emergency service to replace or supplement existing wire systems in event such systems become inoperative or insufficient due to emergency conditions.

March 14: Three construction permits granted the Bell Telephone Co. of Pennsylvania for new portable special emergency radio stations to use a frequency of 2726 kc with 50 watts each; also granted licenses to cover them. The stations equipment is to be used for emergency service to replace or supplement existing wire systems in the event such systems become inoperative or insufficient due to emergency conditions. The station may also be used for communication with points to which no other means of communication are available in cases where life and property are endangered by such emergency or for service purposes in repairing the wire systems which have been damaged by emergencies.

March 14: Construction permit granted the New England Telephone & Telegraph Co. for a new special emergency station; frequency 2726 kc, 50 watts; also granted license to cover it. Station is to be used for emergency service to replace or supplement existing wire systems in event such systems become inoperative or insufficient due to emergency conditions.

Illinois Commerce Commission

March 21: Continued hearing in Springfield on the commission's citation, on its own motion for the Illinois Bell Telephone Co., to show cause why an order should not be entered requiring it to construct and install telephone facilities and render service in River Oaks, West Cottage Hills, North Cottage Hills, South Cottage Hills and Fairfield subdivisions and territory adjacent thereto in Fosterburg Township, Madison County.

March 21: Continued hearing in Springfield on the application of the Illinois Commercial Telephone Co. to increase rates for the telephone service in Bethany, Evansville, Fairbury, Low Point, Coulterville and Washburn. Protest filed by Geo. Thomas, mayor of Coulterville and others against proposed increase in rates in that place.

March 22: Continued hearing in Chicago on the Illinois Allied Telephone Co.'s application to increase rates for service in Dover, Ladd, LaMoille, Manlius, Ohio, Princeton, Sheffield, Spring Valley, Tiskilwa, Walnut and Wyanet.

Missouri Public Service Commission

March 16: Applications filed by B. F. Murphy to sell and Charles E. Murphy to purchase the Bourbon Telephone Exchange.

New York Public Service Commission

March 17: Order issued directing nine companies to remove from their tariff schedules by April 1, provisions which the commission said sought to relieve the companies of liability arising from negligence or misconduct of officers, agents or employes in connection with errors or omissions from directories. The companies affected by the order are: New York Telephone Co.; Chenango & Unadilla Telephone Corp.; Highland Telephone Co.; Jamestown Telephone Corp.; Orange County Telephone Co.; Oswego County Independent Telephone Co.; Rochester Telephone Corp.; Tri-State Associated Telephone Corp.; and Upstate Telephone Corp. of New York.

April 13: Hearing in Watertown on complaint regarding the toll rates of the Upstate Telephone Corp. of New York filed by subscribers of the company who reside in Henderson, Jefferson County.

Ohio Public Utilities Commission

March 13: The commission approved rate increase for the following exchanges of the Ohio Bell Telephone Co. upon conversion of the service from

magneto to dial type: Christiansburg, Lena, Fletcher, New Carlisle, and Sedalia. The types of service listed in the new schedules include one and two-party business, business rural, one and four-party residence; and residence rural.

March 15: The commission authorized the Eastern Telephone Service Co. to re-issue in a consolidated form its existing schedule governing service in Adamsville, Frazeysburg, Palmyra and Windham.

March 15: The commission authorized the Ohio Central Telephone Corp. to file a schedule of rates for automatic service, to be taken at the option of subscribers in its New Winchester exchange, as follows: Business independent, $4.75 per month; business two-party, $4.50; business rural, $3.75; residence, independent, $3.00; residence five-party, $2.25; residence rural, $2.25. A discount of 25 cents per month is made for prompt payment.

March 16: The commission certified its report of the application of the Ohio Associated Telephone Co. to increase rates at Berlin and Baltic.

Oklahoma Corporation Commission

March 16: The commission dismissed the complaint of H. H. Harris (owner of the Martha Telephone Co. which operates in Elgin, Headrick, Drummond and Martha) against the Southwestern Bell Telephone Co. In his complaint Mr. Harris alleged that the Southwestern Bell company had invaded his territory near Headrick. He also complained that the Southwestern Bell Telephone Co. was building a metallic line east from Altus to the Skinner Service Station, connected with his lines and that it was securing subscribers in his territory.

The Bell company and Mr. Harris reached an agreement by which a territorial division line was established between Altus, the Bell terminal, and Headrick. A tier of sections was also designated between the two points in which either Mr. Harris or the Southwestern Bell company could solicit business.

April 28: Representatives of all telephone companies, excepting the Southwestern Bell Telephone Co., covered by a previous order, summoned to appear on this date in Oklahoma City, and to show cause why monthly differential charges on handsets should not be discontinued or modified.

Wisconsin Public Service Commission

March 15: Approval given application of the Commonwealth Telephone Co. to purchase the Ferryville Telephone Co. for the sum of $69.90.

March 22: Further hearing in Madison on application of Menomonee Falls Telephone Co. for authority to increase its rates.

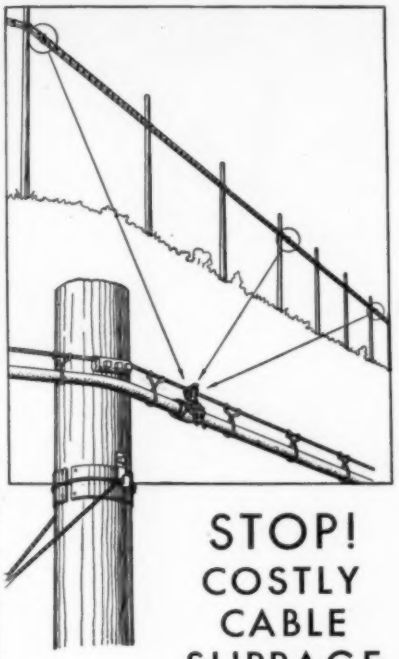
March 22: Hearing in Wausau on application of the Rib Lake Telephone Co. for authority to purchase and Westboro Telephone Co. for authority to sell, the property of the latter. Date of hearing changed from March 1.

March 23: Hearing in Rice Lake in commission's investigation of the adequacy of telephone service being furnished by Cumberland Telephone Co. to Cumberland subscribers.

March 24: Hearing in Madison on application of the Platteville-Cornelia Telephone Co. for authority to dissolve because of transfer of company lines to the Platteville, Rewey & Ellenboro Telephone Co.

ANSWERS TO TRAFFIC QUESTIONS ON PAGE 28

1. Please refer to preface.
2. If the person answering the telephone refuses to talk say, "All right, sir," clear the toll circuit and enter "call not accepted (time)" in the space for reports. Say to the calling party: "Shall I try your call later?" If the answer is in the affirmative and the calling party does not specify a time, offer to try the call in about 20 minutes.
   Consider this equivalent to a DA condition and do not change the classification of the call. However, if the calling party asks you to find out how soon the party at the called station will be ready to talk, tell him that if such action is taken, the charge will be the same as that on a call for a particular person. If he still wishes the action taken, print "P" in the "Person" space, underline the report received from the called station, and proceed as on a call for a particular person. In this case, if the call is canceled, it will be subject to a report change.
3. Yes.
4. Ring for two minutes at intervals of ten seconds. If the called station does not answer within two minutes from the establishing of the connection, give a don't answer report to the calling party, saying: "I am sorry, they do not answer." On connections on which voluntary supervision is given, if the called party does not answer within 30 seconds after the operator's acknowledgment of the call, say to the calling party, "I am trying to get them," and continue ringing.
5. This action is not necessary when new numbers are listed in directory used by information operator.



STOP!
COSTLY
CABLE
SLIPPAGE
with
KEARNEY
GRADE CLAMPS

PREVENT cable from slipping on grades — at tap cables, terminal ends or corners and — where the underground is spliced to aerial cable. With Kearney Grade Clamps you can overcome cable difficulties which have been taking up your time — consuming your ultimate profits. Kearney Cable Clamps have been simplified in design to provide easy, quick installa- and assure positive holding power without injury to cable. You'll find many profitable uses for these clamps and — they reduce your unsightly cable slippage problems.

3 Cable Sizes

For Proof of Efficient Results
Ask About A Trial Order

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

DISTRIBUTED THROUGH JOBBERS

TELEPHONE ACCESSORIES

Manufacturers' Department

Cook Electric's New Protected Cable Terminal

A new protected cable terminal, the S-20, has been announced by Cook Electric Co., Chicago, manufacturer of telephone terminal and protection equipment.

The S-20 is a newly-designed, pressed-steel terminal, in a hot galvanized finish. It is light in weight but extremely rugged and durable. Insulation is of hard rubber and bakelite. The cable enters the moisture-tight cable chamber through the Cook self-soldering nozzle, which is placed well to the rear of the terminal to bring the cable close to the pole.

The pure zinc cover of the cable chamber is placed directly at the front of the terminal, thus making the cable connections on the inside of the cable chamber readily accessible while the terminal is in service.

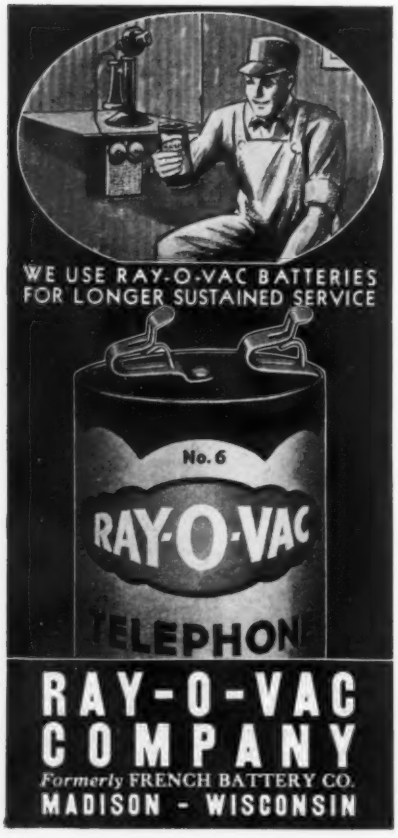
Sturdy Everdur alloy studs for terminating subscribers' drops are located in two rows down the front of the terminal. Insulating fanning strips are placed alongside the drop terminals to keep the drop wires in orderly arrangement. The drops enter the base of the terminal through an insulating plate equipped with a knockout for each drop wire. This excludes insects and dirt.

True-Gap lightning arresters are at the front of the terminal so as to be readily accessible to maintenance men. Secondary lightning arresters are also placed on the subscribers' drop connections to furnish high-voltage protection after a fuse has blown.

The protection on this terminal is mounted in units of one pair each. Thus only the desired number of cable pairs need be equipped with protection. The remaining pairs may be left unoccupied or used as unprotected. Additional protector units can be readily installed at any time.

Each pair of protection is a complete unit in itself, consisting of two subscriber's drop terminals, two primary lightning arresters, two secondary lightning arresters, and two fuses, all mounted on a heavy piece of high-strength bakelite. It is attached to the terminal, ready for service by simply placing it in position and tightening two screws.

The new S-20 terminal has 14 outstanding features, according to the manufacturer.



Catalog Page Folders Issued by Seymour Smith

A new set of catalog page folders have recently been issued by Seymour Smith & Son, Inc., Oakville, Conn., manufacturers of line clearing tree pruners and other tools.

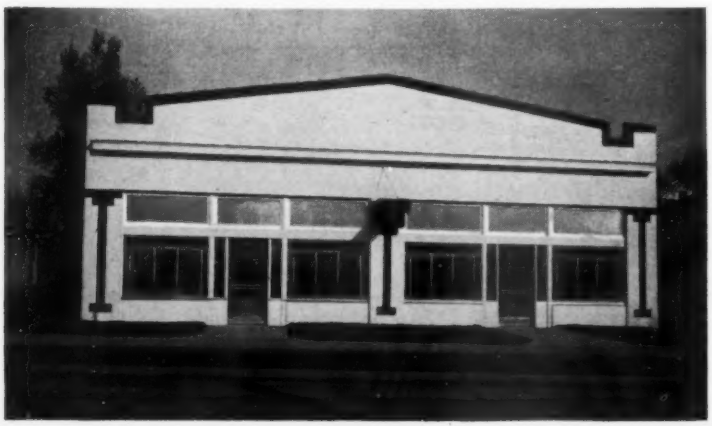
The 12 catalog page folders thoroughly cover each one of the various items manufactured by the company for use by telephone companies. Illustrations picture the various tree pruners, pole pruning saws, jointed pike poles, pruners and brush cutters and cable cutters. In addition, descriptions, detail construction features and prices are shown for each individual item.

Kirkland, Wash., Starts Year With New Switchboard

Heading the Pacific Northwest's parade of telephone progress for 1939 is the Lake Washington Telephone Co. of Kirkland, Wash. On the first day of the year, the company put into service a new three-position, common battery, Automatic Electric Company manual switchboard.

The new Kirkland board handles 300

The strikingly modern new telephone building at Kirkland, Wash.



Three-position Automatic Electric common battery switchboard installed at Kirkland, Wash., and cut into service with the arrival of the new year.

lines locally, as well as 18 toll circuits from Seattle. Five lines from the company's neighboring Strowger automatic exchange, installed at Redmond in 1927, also trunk into Kirkland.

With the assistance of Automatic Electric Company's field engineers, General Manager David Burr was able to make the cut-over at the end of a year which completed his 25th year of management of the exchange.

Since Mr. Burr purchased the Lake Washington Telephone Co., in 1913, he has built the business from 225 stations to the present 1200 subscribers. To give these subscribers good telephone service, and provide for the continuing growth of the business, were his primary objects in installing the enlarged modern equipment.

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New Line of Sturgis Posture Chairs for Operators

With the choice of six different styles of seats and six different styles of back assemblies that can be had in any combination, the new line of Sturgis posture chairs for operators offers wide latitude for a choice of operators' chairs to meet the specific requirements of any exchange.

There are seats upholstered in genuine leather frieze fabric, cane and perforated birch in a variety of shapes and sizes. Six styles of back assemblies are supplied in plaited or plain curved backs, upholstered in either genuine leather or frieze fabric. Mohair, frieze fabric is gaining favor with the operating companies because it does not shine clothing like leather and remains warm in winter, cool in summer.

Not only do the Sturgis chairs offer great variety of seats and backs, but they also offer a wide selection of colors—brown, green, maroon and black enamel. Leather upholstery is furnished in brown, blue-green, black, maroon, and red, while mohair frieze fabric comes in brown, green or maroon.

Sturgis operators' chairs, distributed by the Stromberg-Carlson Telephone Mfg. Co., are designed to increase operator efficiency by reducing fatigue through construction that induces correct posture.

There are models to meet the requirements of low switchboards and others equipped with foot-rests to meet the needs of high switchboards. Each chair can be adjusted to suit the needs of an operator.

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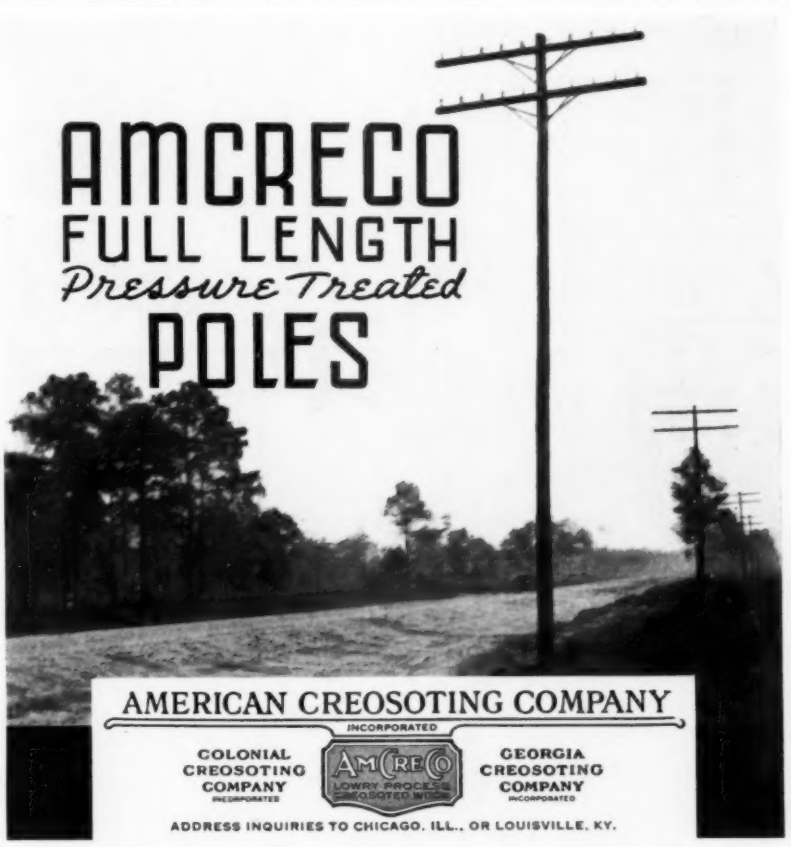
Wires Down; Company Orders by Radio

W8NF, short-wave amateur station at Litchfield, Mich., helped the Litchfield Telephone Co. put through a hurry-up call for supplies Monday morning, March 13, after a sleet storm had crippled the company's lines and halted long distance communication.

By noon of the same day, drop wire, line wire, brackets, and other emergency supplies for Litchfield's rehabilitation were rolling out of the Chicago warehouses of American Automatic Electric Sales Company.

The Indiana State Police at Indianapolis had picked up the radio "S.O.S." and relayed it by telephone to the Chicago supplier for whom it was intended. Confirmation followed a few hours later, when the Illinois State Police reported receiving the message from the Indiana police.

Putting the radio order through the usual checking routine applied to all orders, the supplier noted an item on which additional verification was desired. Accordingly, aid of the Illinois State Police was enlisted and they con-



The Anti-Sidetone Subscriber Set (Cont.)

The modern local battery anti-sidetone circuit is practically the same as the old familiar operator's anti-sidetone circuit which has been in use for many years.

The Local Battery Anti-Sidetone Circuit

A basic local battery anti-sidetone circuit is shown in Fig. 9. It will be observed that a three-winding induction coil and a balancing resistor is used in this circuit. It can be seen that this is merely a Wheatstone bridge circuit with the transmitter and receiver comparable to the battery and galvanometer of the bridge. The balancing network in one of the bridge arms tends to balance the line impedance.

When transmitting, the voltage induced in the two windings will, in the ideal case, establish currents in the two arms of the bridge which will set up the same voltage drop across winding 3-4 and the balancing resistance as across winding 5-6 and the line impedance. Under this condition the net voltage across the receiver will be zero and no sound will be heard when transmitting. As has already been stated this ideal condition is not realized in practice, due to the fact that the circuit is balanced for only one frequency and value of line impedance. Sidetone reductions of from 5 to as much as 25 db can be obtained in practical applications of this circuit.

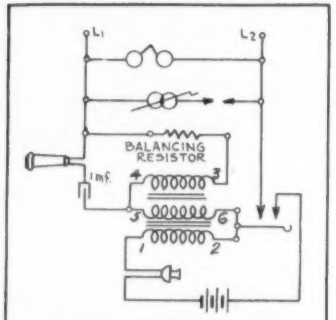


FIG. 9. LOCAL BATTERY ANTI-SIDETONE CIRCUIT.

The resistance of the balancing resistor will be governed by the line impedance. Tests recently made by the writer on a local battery anti-sidetone set, show that where the set is used on long iron wire lines

the resistor should be about twice the value which is recommended for local lines, or lines feeding directly into cable.

An examination of the circuit shown in Fig. 9 at first would seem to indicate that the usual practice of connecting a ½ or 1 mf condenser in series with the receiver to prevent an eavesdropping subscriber from interfering with ringing, would not be effective because the ringing current can pass through the two windings, which are directly across the line and in series with the balancing resistor.

Tests made on an actual circuit show that with a properly-designed anti-sidetone coil the impedance of the coil and balancing resistor is sufficient to prevent a serious shunting effect on line signaling current. It is imperative, however, that either a 1 or ½ mf condenser be used in series with the receiver in order to increase the impedance to ringing currents of the path through the receiver.

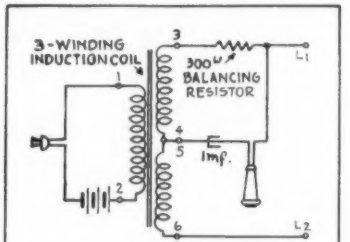


FIG. 10. SIMPLIFIED SCHEMATIC OF LOCAL BATTERY ANTI-SIDETONE CIRCUIT.

The complete local battery anti-sidetone circuit suitable for a wall type magneto telephone is shown in Fig. 10. It will be seen that this circuit is the same as that of Fig. 9 with the exception that one end of the primary winding and one of the secondary have been tied together in order to permit the use of a standard three-contact hook-switch.

The transmission improvement that can be obtained from local battery anti-sidetone sets offers real possibilities for long farm loops where transmission is poor. Old sets can be either replaced by new anti-sidetone sets, or the old sets converted to the new circuit by

substitution of an anti-sidetone coil and improved high efficiency receivers.

To take full advantage of the improved transmission resulting from anti-sidetone sets, some of the larger operating companies are now using this type set exclusively on all new installations and plan on converting, over a period of time, all suscribers' sets. In considering the possible application of anti-sidetone sets to a plant the following points should be kept in mind:

(1) The general use of anti-sidetone sets in a given area will result in either a higher grade of transmission being rendered, or permit smaller gauge cable to be used with resultant plant economies.

(2) Rural subscribers served over long iron wire lines, can be furnished improved transmission by the use of the anti-sidetone circuit plus the new high efficiency transmitters and receivers.

(3) Small unprofitable exchanges can, in some cases, be cut to nearby larger exchanges; and by providing these subscribers with the latest type of anti-sidetone sets, they will be able to talk with one another without the usual "let down" in transmission that results when an exchange is abandoned and the subscribers cut to another exchange some distance away.

(4) Subscribers whose telephones are in a noisy location should in all cases be provided with anti-sidetone sets.

Conclusion

Telephone companies, particularly the larger ones, should work out a program looking to the eventual conversion of all instruments to the anti-sidetone circuit. Initially anti-sidetone sets should be used to replace existing instruments located in noisy places. Obsolete sets which require replacement can logically be replaced with the new type. Instruments which pass through the shop for repair and adjustment can be converted to the new circuit.

By consistently carrying forward a gradual replacement program, the advantages inherent to the sidetone circuit can ultimately be realized.

tacted directly the Litchfield amateur who had sent the original dispatch for the emergency supplies.

Receipt, confirmation, verification, filling, and shipment of the order required only 2½ hours.

▼ ▼

ELECTRONIC DEVICES IN TELEPHONY

(Continued from page 13)

ing. Inside the cylinder, and insulated from it, is placed a filament through which the heating current passes.

The heat is transferred to the surrounding cylinder, and the oxide coating emits electrons into the tube. The coated cylinder is called the *cathode*, the current-carrying filament is called the heater, and the combination a separate-heater cathode. Because of their wide use and circuit simplicity, many of the future illustrations will use these tubes.

Summary

In the screen-grid tetrode, the plate is effectively shielded by the screen grid. As a result of this, the capacitance between the plate and control grid is reduced, and the tendency to oscillate when used as a radio-frequency amplifier is lessened, thus simplifying circuit design. The shielding of the plate also makes changes of plate voltage ineffective in controlling the plate current. Thus, a tube with a high amplification factor results.

The effects of secondary emission are very pronounced in the screen-grid tube. For satisfactory operation, the plate potential must not fall below that of the screen grid. When a suppressor grid is inserted between the plate and control grid, these objectional secondary emission effects are prevented. This is done in the suppressor-grid pentode.

In this tube, the plate is shielded by the suppressor grid in addition to the screen grid. This additional shielding reduces even more the control of the plate on the electron current flow. Thus, the result is a tube having (usually) an amplification factor even greater than that of the screen-grid tube.

The word usually is inserted because the power-output pentode, which also contains a suppressor grid, is so designed that considerable power output, but lower amplification is obtained than with the voltage amplifying pentodes just described. The difference between power-output tubes and voltage-amplifying tubes will be treated in a future article. In the next article of this series, rectifiers will be treated.

COMING CONVENTIONS

Oklahoma Telephone Association, Huckins Hotel, Oklahoma City, March 27 and 28.

Kansas Telephone Association, Hotel Bartell, Junction City, March 30 and 31.

Missouri Telephone Association, Hotel Muehlebach, Kansas City, April 3 and 4.

Nebraska Telephone Association, Lincoln Hotel, Lincoln, April 11 and 12.

Georgia Telephone Association, Piedmont Hotel, Atlanta, April 13 and 14.

Iowa Independent Telephone Association, Fort Des Moines Hotel, Des Moines, April 18-20.

Ohio Independent Telephone Association, Deshler-Wallick Hotel, Columbus, April 25 and 26.

Indiana Telephone Association, Claypool Hotel, Indianapolis, May 10 and 11.

Conference of class A and B member companies, U. S. Independent Telephone Association, Chicago, Stevens Hotel, May 15 and 16.

Pennsylvania Independent Telephone Association, Yorktowne Hotel, York, May 18, 19 and 20.

New York State Telephone Association, Hotel Syracuse, Syracuse, May 23, 24, 25 and 26.

The Illinois Telephone Association, Pere-Marquette Hotel, Peoria, June 7 and 8.

Wisconsin State Telephone Association and Wisconsin Locally Owned Telephone Group, Park Hotel, Madison, June 13-15.

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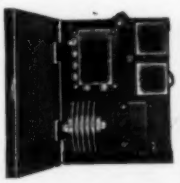

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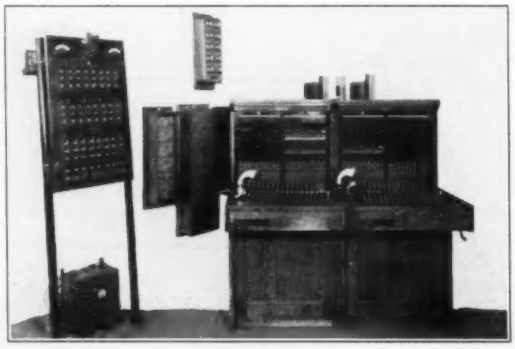

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